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## PROBLEMS.

44. Proposed by I. J. SCHWATT, Ph. D., Professor of Mathematics, University of Pennsylvania, Philadelphia, Pennsylvania.

(1). If from the middle point  $M$  of the side  $BC$  of the triangle  $ABC$  a parallel to the bisector  $AF$  of the external angle to  $ABC$  is drawn to meet  $AB$  at  $K$ , the point  $K$  divides then the side  $AB$  in  $KA$

$$= \frac{1}{2}(AB + AC) \text{ and } KB = \frac{1}{2}(AB - AC).$$

(2). If  $K$  is joined to the extremity  $D$  of the diameter perpendicular to  $BC$  then is  $KD$  perpendicular to  $AB$ .

45. Proposed by B. F. BURLESON, Oneida Castle, New York.

Determine the radius of a circle circumscribing three tangent circles of radii  $a=15$ ,  $b=17$ , and  $c=19$ .

## CALCULUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

## SOLUTIONS OF PROBLEMS.

30. Proposed by E. W. NICHOLS, Professor of Mathematics in the Virginia Military Institute, Lexington, Virginia.

Given the cardioid  $r=a(1-\cos \theta)$ ; find the area of its circumscribing square formed by tangents making angles of  $45^\circ$  with its axis.

I. Solution by Professor G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let  $OPRSQ$  be the cardioid. Draw  $PQ$  through the cusp perpendicular to the initial line  $AC$ . From the property of the cardioid the angle  $APO$ , made by the tangent and radius vector at  $P$ ,  $=\frac{1}{2}\angle POA$ . But  $\angle AOP=\frac{1}{2}\pi$ .  $\therefore \angle OPA=\angle OAP=\frac{1}{4}\pi$ .  $\therefore$  the tangents  $BA$ ,  $DA$  at the points  $P$ ,  $Q$  are inclined at an angle of  $45^\circ$  to the axis and are perpendicular to each other. Draw the radii vectors  $OR$ ,  $OS$ , making the  $\angle ROP=\angle SOQ=\frac{1}{3}\pi$ , and draw the tangents  $CB$ ,  $CD$  at the points  $R$ ,  $S$ . Then  $\angle ROP=\angle SOQ=\frac{1}{3}\pi$ ,  $\angle OPB=\angle OQD=\frac{3}{4}\pi$ ,  $\angle ORB=\angle OSD$

$$= \frac{5}{12}\pi.$$

$$\begin{aligned} \therefore \angle ROP + \angle OPB + \angle ORB \\ = \angle SOQ + \angle OQD + \angle OSD = \frac{3}{2}\pi. \end{aligned}$$

$\therefore \angle B = \angle D = \frac{1}{2}\pi$ , an  $ABCD$  is the required square.

